SIEMENS

Case Study

Industry Sector
Building Technologies Division

Herzogenaurach, February 3, 2011

Innovative building automation concept for PUMAVision Headquarters in Herzogenaurach
Intelligent system concept for maximum comfort

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Sportlifestyle company PUMA claims to have built the first climate-neutral corporate headquarters in its industry. All electricity for the new 35,000 m^2 company headquarters comes from renewable energy sources. The interdisciplinary Desigo building automation system from Siemens has been instrumental in reaching this goal. Concrete core temperature control is used for basic heating and cooling of the main building. Some of the heating and cooling is generated by two heat pumps.

Sustainable construction and operation of buildings and production facilities has become enshrined in the corporate philosophy of more and more companies. Based on its sustainability concept called “PUMAVision”, the German sportlifestyle company headquartered in Herzogenaurach has constructed a building complex where established, proven and innovative technologies are combined in intelligent ways. The PUMAVision Headquarters, designed by Klaus Krex of Nuremberg-based architecture firm da capo al fine Architekten, consists of the administration building (dubbed “Office”), a company conference center (“Brand Center”) and a PUMA Store (“Retail Building”). Basic heating and cooling for the Office building comes from thermally activated concrete slabs; additional heating or cooling to achieve comfortable temperatures comes from façade-oriented fan coils operated via individual room controllers and from radiators. Because the Retail and Brand Center buildings are used in very different ways, no concrete core temperature control—also called thermo-active building systems (TABS)—was installed there. Centrally located partial air-conditioning systems supply each room with the hygienically required air volume.
To achieve climate-neutral building operations—one of the goals PUMA set for itself—the electricity used by the company comes from Lichtblick AG in Hamburg (renewably generated), from a 1,000 m^2 photovoltaic installation on the roof of the Retail building, another 140 m^2 of photovoltaic modules incorporated into the façades as well as a wind farm in Turkey as a carbon offset project.

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The most important tool to maintain efficient and economical building operations is the interdisciplinary Desigo building automation system, planned and deployed by system house IPM – Innovatives Projekt Management für Gebäudeleittechnik GmbH, located in Feucht near Nuremberg. IPM is a solution partner of Building Technologies (BT), a division of Siemens.

System house for building management technology brought on board at an early stage

Nuremberg-based Haustechnik Planungs GmbH was responsible for the planning of the extensive electrical, cooling, heating, ventilation and air-conditioning systems for PUMAVision Headquarters. Experience has shown that the overall energy efficiency of a building largely depends on the size of the heating/cooling generators, the hydraulic components, the subdivision of the control loops and interdisciplinary interfaces, for instance to lighting and sun protection. For this reason, system house IPM was brought on board at an early stage of the project. IPM control experts made valuable contributions to the design of the hydraulic system since the concrete core temperature control deployed in the Office building poses challenges as far as hydraulic and control technology is concerned.

At the core of heat generation are four plate heat exchangers with an equal-percentage characteristic as part of a district heating transfer station with a total of approximately 2,000 kW; they have been sized in such a way that in the summer a heat exchanger reduced to a heating capacity of 200 kW is sufficient for heating. This allowed the control performance to be increased significantly. All recirculating pumps (heating and cooling) are demand-based; they are controlled by sensors which detect the weakest spot in the system in terms of energy flow. Heating and cooling for the concrete core temperature control system is handled by two heat pumps, each with a heating capacity of 145 kW and a cooling capacity of 225 kW.

Siemens-developed and lab-tested control modules based on the Desigo PX automation station are used to control the thermoactive building system in the Office building. Initial operational experience has shown that the concrete core temperature control heating system is turned off when the outside temperature reaches 12°C; the Office building then heats itself. To allow additional heating and cooling via individual room control, the concrete core temperature control system is switched from summer to winter operations on demand by sensing the room loads. Additional heating or cooling is achieved by means of radiators and fan coils respectively.

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Individual room control using pre-tested macros

As was the case for the concrete core temperature control system, IPM used pre-tested macros from the Desigo program, which can be customized as needed, for individual room control. To streamline assembly and deployment, nine room types were defined for a LON-based room automation system. In addition to demand-based heating, cooling and ventilation, most RXC room controllers also handle lighting and sun protection. Most office lighting is overridden by occupancy detectors and photoelectric switches; this means that lights are turned off automatically if a room is unoccupied or if there is sufficient daylight.

The biggest challenge to be addressed in the room automation concept was how to topologically interconnect the approximately 430 individual room controllers over a LON network. The ability to configure rooms flexibly, expressly requested by PUMA, made matters even more difficult, especially since the connection options between floor and ceiling are very limited and mostly restricted to the shaft heads. In basic terms, two window elements with heating and cooling unit, sun protection blinds and light strip form an ERR grid; one or more ERR grids can be combined on one operating unit. All hallway lighting is controlled by timer programs that can be overridden if needed, for example by office cleaning crews.

Throw distance adjustment in multimedia hall

Separate central air-conditioning systems are used to ventilate and condition the Retail building with its PUMA Store, merchandising center and restaurant as well as the Brand Center with its multimedia hall and multiple meeting rooms. One special feature of the PUMA headquarters is the ability to adjust the throw distance of the air outlets in the multimedia hall. If cooling is needed, the conditioned air is diffused; if heating is needed, the warm air is blown straight down from the ceiling. Because of the high internal thermal load in the hall, the basic ventilation system is enhanced by four recirculating air cooling units. Multiple scenarios for event-appropriate heating and cooling are stored in the hall's control system to allow for a variety of applications. To ensure optimal HVAC control performance for the hall, which has a capacity of 1,500 people, IPM opted for four RF sensors from EnOcean. They were installed after the interior of the hall had been completely finished.

Data coupling via BACnet and Modbus

The basic principle of the control concept is to supply heating and cooling only if actually needed—and to transport only those volumes over the respective duct networks that are required to avoid a loss of comfort for the consumer. All heat consumers are recorded and controlled via Desigo PX stations. Predefined and calculated setpoints are forwarded to the corresponding pre-control group where they are converted into matching “demand signals”. The recirculating pumps for the heating

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groups and the chilled-water system are incorporated into the demand-based control strategy. The required water volume is calculated, controlled and monitored based on demand, either by sensors which detect the weakest spot in the system in terms of energy flow, or by the corresponding heating/cooling consumers. The control system is enhanced by comprehensive energy management functions which extend from the room level to the heating/cooling generators and ensure demand-based operation.

Topologically speaking, the instrumentation and control/building automation network is divided into ten main information areas and encompasses 5,000 datapoints. The main information areas are connected to the buildings via fiber optic cables, and within the buildings via a TCP/IP network. The complex cooling plant with its proprietary control technology is connected to the building automation system via Modbus for energy guidance and monitoring. BACnet is used for data coupling to the electrical systems to control interdisciplinary functions such as the weather station with wind monitor, blinds, as well as the operating panels which control building services, ventilation and lighting in the conference rooms. Other connected systems include the smoke extraction units with a combined capacity of 500,000–600,000 m^3/h, the transformer stations (Retail building with two 2 MW transformers, Office building with three 3.75 MW transformers) as well as the emergency power supply/emergency generator system. The topology of the building automation system allows existing and future assets to be easily integrated into the system structure.

Remote access was added to provide support for operations, service work and complex software maintenance tasks required for the process stations. When designing the building automation system for the building complex, IPM focused on room flexibility, upgradability, addition of new control groups and a sensible control cabinet layout in order to facilitate operation of the systems. For example, the cabinet doors have controls for manual operations to make it easier to perform maintenance tasks and energy efficiency measures.

***About the authors**

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Bildlegenden (Auswahl)

Abb. 1 (PUMAVision_Headquarters3.jpg)
PUMAVision Headquarters, with the Retail building shaped like a shoebox (left) and the administration building (right)

Abb. 2 (BT_IPM_Foyer_3257.jpg)
Lobby of the Administration building, decorated with World Cup jerseys of different national soccer teams

Abb. 3 (BT_IPM_Halle_3309.jpg)
Multi-purpose hall in Brand Center. The blower nozzles of the HVAC system can be adjusted to diffuse (cooling) or direct (heating)

Abb. 4 (BT_IPM_BKT-Steuerung_3297.jpg)
The concrete core temperature control system in the office building is controlled using an application developed by Siemens and extensively tested in the laboratory

Abb. 5 (BT_IPM_Wärmepumpe_3291/3292.jpg)
All heat pumps and chillers—a total of nine units—are located on the roof of the Adminstration building

Abb. 6 (BT_IPM_PX_3332.jpg)
Control cabinet with attached PX automation station and manual controls in the door

Source: Siemens

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(in Kasten in den Text)

The new PUMA headquarters at a glance

Construction:	November 2007 until July 2009
Plot size:	49,801 m^2
Floor space:	34,565 m^2
Enclosed space:	173,500 m^3
Employees:	700

Architect Klaus Krex, da capo al fine Architekten, Nuremberg

Overall planning for HVAC, sanitation, and electrical systems

Haustechnik Planungs GmbH, Nürnberg

Instrumentation and control/building automation engineering IPM Gebäudeleittechnik GmbH, Feucht

Building specifications

Heat from district heating 2,000 kW

- Heating load—static heating approx. 850 kW
- Heating load—HVAC systems approx. 1,150 kW
- Heating requirement in summer (separate heat exchanger) approx. 50 kW

  Air volume of all ventilation systems: approx. 500,000 m^3

Heat pumps for concrete core temperature control 2

- Heating capacity 290 kW
- Cooling capacity 450 kW

Chillers 7

- Cooling capacity—sales areas 526 kW
- Cooling capacity—office A/C 2,490 kW
- Cooling capacity—IT 400 kW

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